

# PATENT SPECIFICATION

749,731



Date of filing Complete Specification: Nov. 24, 1954.

Application Date: Dec. 10, 1953.

No. 34458/53.

Complete Specification Published: May 30, 1956.

Index at acceptance:—Class 85, B4.

## COMPLETE SPECIFICATION

### Improvements relating to Bridging Plugs for Bore Holes.

We, THE BRITISH PETROLEUM COMPANY LIMITED (previously known as Anglo-Iranian Oil Company Limited), of Britannic House, Finsbury Circus, London, E.C.2, a British joint-stock Corporation, and ARTHUR CLARK and JOHN MACFARLANE GIBSON, both of P.O. Box 1, Southwell, Nottingham, and both of British nationality, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed to be particularly described in and by the following statement:

This invention relates to bridging plugs for plugging up bore holes e.g. oil wells.

It is an object of this invention to provide a bridging plug which is cheap and easy to construct, which can be simply and positively located at the required depth in a bore hole and which is easily set.

It is a further object of the invention to provide a bridging plug which can be set either in a cased or an uncased hole.

Yet a further object of the invention is to provide a bridging plug which is made of a readily destructible material whereby it may subsequently be easily removed by drilling without any fishing job having to be done.

According to the invention, a bridging plug comprises a number of longitudinal sections forming a cylindrical outer plug having an axial bore which is of uniform cross section at its upper end and part or all of the remainder of which tapers so as to increase in diameter towards the lower end, and an inner plug or mandrel which is shaped to fit the bore of the outer plug, the outer plug being adapted for connection to the end of a drill pipe whereby it may be lowered into a bore hole to the desired depth, and the inner plug being provided at its upper end with means for enabling a connection to be made to a fishing tool lowered down the hole whereby the inner plug may be drawn upwardly within the outer plug so as to break the connection between the drill pipe and outer plug and force the sections of the latter hard against the

wall of the hole, and the said means being adapted to be broken away subsequently from the inner plug so as to leave the bridging plug set in the well.

Advantageously the inner and outer plugs are made of wood or other destructible material whereby the plug may subsequently be easily drilled out if desired.

The means for enabling a connection to be made to a fishing tool may consist of a member having a hollow cylindrical lower portion which is split so as to make it a push fit over the top of the inner plug, and an upper portion comprising a serrated fishing pin, the member being connected to the top of the inner plug by means of a shear pin.

Means may be provided for holding the sections of the outer plug together before expansion. Such means may be spring coils, rubber bands, or copper wire wound round the sections and held by staples.

Means may also be provided for initially holding the inner plug in position in the outer plug before the latter is expanded. Such means may be a wooden dowel pin which shears when the inner plug is drawn upwardly within the outer plug.

The outer plug may be connected to a drill pipe by means of wood screws passing through holes in a flange welded to the end of the drill pipe.

The invention will now be described by way of example with reference to the drawings accompanying the provisional specification in which

Figure 1 is an exploded sketch of the plug and associated parts,

Figure 2 is a view of the outer plug looking in the direction of arrow A in Figure 1, and the accompanying drawing in which

Figure 3 is a sectional elevation of the assembled plug and associated parts.

The outer plug 10, is made of wood (e.g. beech) and consists of six sections 10a, 10b, 10c, 10d, 10e and 10f which form a cylinder having a bore 11 which is partly tapered (11a)

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and partly cylindrical (11b). The assembled plug is provided with three annular grooves 12 whereby the sections may be held together by copper wire wound twice round the plug 5 in the grooves and held together by staples. Alternatively spring coils or rubber bands may be used to hold the sections together. The outer plug 10 is secured by means of wood screws 13 to a metal flange 14 which is 10 welded to the end of a drill pipe 15. Six wood screws 13 are used—one for each section of the outer plug 10. The pipe 15 is provided with a hole 16 for equalising fluid pressure in use. A hole 17 is drilled through the outer 15 plug 10 and in it is located a wooden dowel pin 18. The inner plug 19 which is also made of wood (e.g. ash) is formed with a tapering portion 20 and a cylindrical portion 21 to correspond with the bore of the outer plug 20 10. A socket 22 is formed in the inner plug 19 so that when the inner plug is in position in the outer plug the wooden dowel pin 18 can be pushed through the hole 17 so as to extend into the socket 22 and hold the inner 25 and outer plugs in that position. The inner plug then protrudes from the outer plug at both ends. A hollow metal recovery head 23 is slotted at 24 to make it a push fit over the upper end 25 of the inner plug 19 in which 30 position it is held by a quarter inch diameter brass shear pin 26 passing through holes 27 and 28 in the recovery head and inner plug respectively. The upper part of the recovery head 23 consists of a serrated fishing pin 29. 35 In use the assembled parts 10, 19, 18, 23, 26 and 15 are lowered on a drilling string into the well to the point where it is desired to make a bridge. To set the plug, a sucker rod fishing tool 30 is run down the well inside 40 the drilling pipe. The fishing tool is fitted with spring loaded slips 31 which are provided with teeth for engaging the serrated fishing pin 29. The fishing tool screws on to a sinker bar 32 which in turn screws on to a rope 45 socket 34 which is fitted with taper slips 33 having serrated hard faces to hold the wire sand line (not shown) on which the assembly is being lowered. Parts 30, 32 and 34 are all made of metal. The fishing tool 30 is lowered 50 until it engages the fishing pin 29 on the recovery head 23. The fishing tool cannot bypass the recovery head since the latter is located inside the drill pipe 15.

When the wire line is pulled up, the inner 55 plug 19, first of all breaks the dowel pin 18. It then expands the outer plug 10 breaking the six sections away from the flange 14 of the drill pipe 15 to which they were attached by the wood screws 13. The latter are either 60 sheared or parted from the plug. The sections of the outer plug 10 are forced tightly against the wall of the hole or casing and the tension in the sand line is increased until the shear pin 26 breaks whereupon the recovery 65 head 23 may be pulled intact out of the well

and the drilling string including the pipe 15 also removed leaving only the inner and outer plugs firmly set in position in the well.

The plug may be used either in cased or 70 uncased hole. In uncased hole, if the diameter of the hole is less at the upper end of the outer plug than at the lower end, then the arrangement of a partly tapered and partly cylindrical inner plug (and corresponding 75 outer plug bore) ensures that when the upper end of the outer plug contacts the wall of the hole the upward movement of the inner plug may be continued until the lower part of the outer plug is also forced against the wall of 80 the hole. If the inner plug and outer plug bore were both wholly tapered then in such circumstances the inner plug would jam as soon as the upper end of the outer plug made contact with the wall of the hole and contact 85 along the lower part of the inner plug would not be made. It is essential that the bore of the drill pipe 15 should be sufficient to ensure that the inner plug does not wedge in it before the outer plug has been fully expanded.

A quarter inch brass shear pin (26) has 90 been found to have an 800 lb. breaking strain which is sufficient to ensure that the plug is tightly set.

What we claim is:—

1. A bridging plug comprising a number of 95 longitudinal sections forming a cylindrical outer plug having an axial bore which is of uniform cross section at its upper end and part or all of the remainder of which tapers so as to increase in diameter towards the 100 lower end, and an inner plug or mandrel which is shaped to fit the bore of the outer plug, the outer plug being adapted for connection to the end of a drill pipe whereby it may be lowered into a bore hole to the 105 desired depth, and the inner plug being provided at its upper end with means for enabling a connection to be made to a fishing tool lowered down the hole whereby the inner plug may be drawn upwardly within the 110 outer plug so as to break the connection between the drill pipe and outer plug and force the sections of the latter hard against the wall of the hole, and the said means being adapted to be broken away subsequently from the 115 inner plug so as to leave the bridging plug set in the well.

2. A bridging plug according to claim 1, in which the inner and outer plugs are made of wood or other destructible material where- 120 by the plug may subsequently be easily drilled out if desired.

3. A bridging plug according to claim 1 or claim 2, in which the means for enabling a connection to be made to a fishing tool 125 comprise a member having a hollow cylindrical lower portion which is split so as to make it a push fit over the top of the inner plug, and an upper portion comprising a serrated fishing pin, the member being con- 130

nected to the top of the inner plug by means of a shear pin.

4. A bridging plug according to any of the preceding claims, in which means are provided for holding the sections of the outer plug together before expansion, the means consisting of spring coils, rubber bands, or copper wire wound round the sections and held by staples.

10 5. A bridging plug according to any of the

preceding claims, in which destructible means are provided for initially holding the inner plug in position within the outer plug before the latter is expanded.

6. A bridging plug substantially as herein- 15 before particularly described with reference to the drawings accompanying the provisional specification and this specification.

T. MACDONALD,  
For the Applicants.

## PROVISIONAL SPECIFICATION

### Improvements relating to Bridging Plugs for Bore Holes.

20 We, ANGLO-IRANIAN OIL COMPANY LIMITED, of Britannic House, Finsbury Circus, London, E.C.2, a British joint-stock Corporation, and ARTHUR CLARK and JOHN MACFARLANE GIBSON, both of P.O. Box 1, Southwell, Nottingham, and both of British 25 nationality, do hereby declare this invention to be described in the following statement:—

This invention relates to bridging plugs for plugging up bore holes e.g. oil wells.

30 It is an object of this invention to provide a bridging plug which is cheap and easy to construct, which can be simply and positively located at the required depth in a bore hole and which is easily set.

35 It is a further object of the invention to provide a bridging plug which can be set either in cased or uncased hole.

40 Yet a further object of the invention is to provide a bridging plug which is made of a readily destructible material whereby it may subsequently be easily removed by drilling without any fishing job having to be done.

45 According to the invention, a bridging plug comprises a number of longitudinal sections forming a cylindrical outer plug having an axial bore which is of uniform cross section at its upper end and part or all of the remainder of which tapers so as to increase in diameter towards the lower end, and an inner plug or mandrel which is shaped to fit the bore 50 of the outer plug, the outer plug being adapted for connection to the end of a drill pipe whereby it may be lowered into a bore hole to the desired depth, and the inner plug being provided at its upper end with means for 55 enabling a connection to be made to a fishing tool lowered down the hole whereby the inner plug may be drawn upwardly within the outer plug so as to break the connection between the drill pipe and outer plug and force 60 the sections of the latter hard against the wall of the hole, and said means being adapted to be broken away subsequently from the inner plug so as to leave the bridging plug set in the wall.

65 Advantageously the inner and outer plugs are made of wood or other destructible material whereby the plug may subsequently be easily drilled out if desired.

70 The means for enabling a connection to be made to a fishing tool may consist of a member having a hollow cylindrical lower portion which is split so as to make it a push fit over the top of the inner plug, and an upper portion comprising a serrated fishing pin, the member being connected to the top of the 75 inner plug by means of a sheer pin.

Means may be provided for holding the sections of the outer plug together before expansion. Such means may be spring coils, rubber bands, or copper wire wound round 80 the sections and held by staples.

Means may also be provided for initially holding the inner plug in position in the outer plug before the latter is expanded. Such means may be a wooden dowel pin 85 which shears when the inner plug is drawn upwardly within the outer plug.

The outer plug may be connected to a drill pipe by means of wood screws passing through holes in a flange welded to the end of 90 the drill pipe.

The invention will now be described by way of example with reference to the accompanying drawings in which

Figure 1 is an exploded sketch of the plug 95 and associated parts, and

Figure 2 is a view of the outer plug looking in the direction of arrow A in figure 1.

The outer plug 10, is made of wood (e.g. beech) and consists of six sections 10a, 10b, 100 10c, 10d, 10e and 10f which form a cylinder having a bore 11 in which is partly tapered (11a) and partly cylindrical (11b). The assembled plug is provided with three annular grooves 12 whereby the sections may be held 105 together by copper wire wound twice round the plug in the grooves and held together by staples. Alternatively spring coils or rubber bands may be used to hold the sections together. The outer plug 10 is secured by means 110 of wood screws 13 to a metal flange 14 which is welded to the end of a drill pipe 15. Six wood screws 13 are used—one for each section of the outer plug 10. The pipe 15 is provided with a hole 16 for equalising fluid 115 pressure in use. A hole 17 is drilled through the outer plug 10 and in it is located a wooden dowel pin 18. The inner plug 19 which is

also made of wood (e.g. ash) is formed with a tapering portion 20 and a cylindrical portion 21 to correspond with the bore of the outer plug 10. A socket 22 is formed in the inner plug 19 so that when the inner plug is in position in the outer plug the wooden dowel pin 18 can be pushed through the hole 17 so as to extend into the socket 22 and hold the inner and outer plugs in that position. The inner plug then protrudes from the outer plug at both ends. A hollow metal recovery head 23 is slotted at 24 to make it a push fit over the upper end 25 of the inner plug 19 in which position it is held by a quarter inch diameter brass shear pin 26 passing through holes 27 and 28 in the recovery head and inner plug respectively. The upper part of the recovery head 23 consists of a serrated fishing pin 29.

In use the assembled parts 10, 19, 18, 23, 26 and 15 are lowered on a drilling string into the well to the point where it is desired to make a bridge. To set the plug, a sucker rod fishing tool 30 is run down the well inside the drilling pipe. The fishing tool is fitted with spring loaded slips 31 which are provided with teeth for engaging the serrated fishing pin 29. The fishing tool 30 screws on to a sinker bar 32 which in turn screws on to a rope socket 34 which is fitted with taper slips 33 having serrated hard faces to hold the wire sand line (not shown) on which the assembly is being lowered. Parts 30, 32 and 34 are all made of metal. The fishing tool 30 is lowered until it engages the fishing pin 29 on the recovery head 23. The fishing tool cannot bypass the recovery head since the latter is located inside the drill pipe 15.

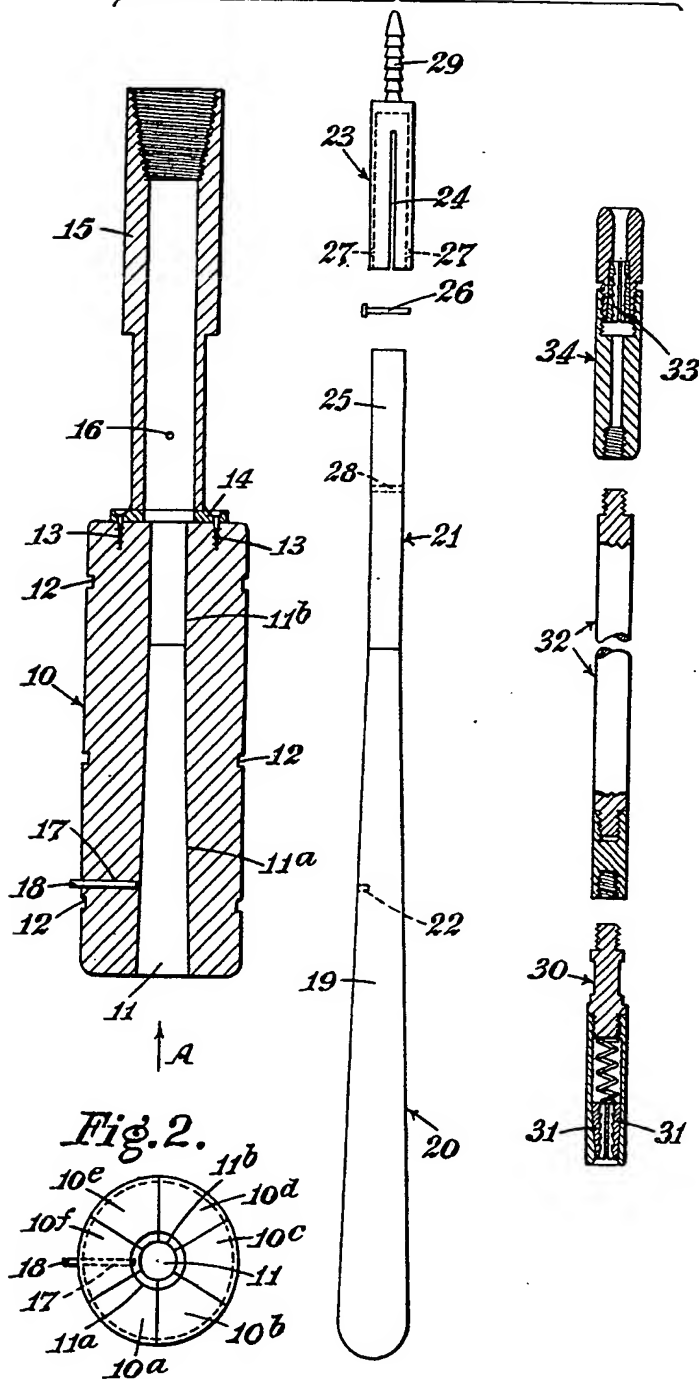
When the wire line is pulled up, the inner plug 19 first of all breaks the dowel pin 18. It then expands the outer plug 10 breaking the six sections away from the flange 14 of the drill pipe 15 to which they were attached by the wood screws 13. The latter are either sheared or parted from the plug. The sections of the outer plug 10 are forced tightly against the wall of the hole or casing and the tension in the sand line is increased until the shear pin 26 breaks whereupon the recovery head 23 may be pulled intact out of the well and the drilling string including the pipe 15 also removed leaving only the inner and outer plugs firmly set in position in the well.

The plug may be used either in cased or uncased hole. In uncased hole, if the diameter of the hole is less at the upper end of the outer plug than at the lower end, then the arrangement of a partly tapered and partly cylindrical inner plug (and corresponding outer plug bore) ensures that when the upper end of the outer plug contacts the wall of the hole the upward movement of the inner plug may be continued until the lower part of the outer plug is also forced against the wall of the hole. If the inner plug and outer plug bore were both wholly tapered then in such circumstances the inner plug would jam as soon as the upper end of the outer plug made contact with the wall of the hole and contact along the lower part of the inner plug would not be made. It is essential that the bore of the drill pipe 15 should be sufficient to ensure that the inner plug does not wedge in it before the outer plug has been fully expanded.

A quarter inch brass shear pin (26) has been found to have an 800 lb. breaking strain which is sufficient to ensure that the plug is tightly set.

T. MACDONALD,  
For the Applicants.

*Fig. 1.*

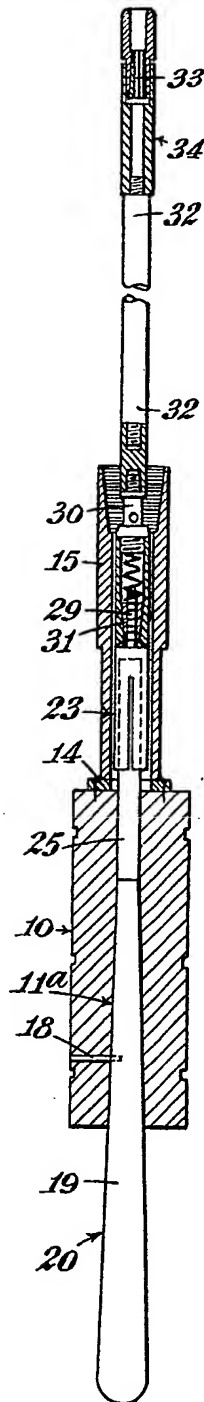


*Fig. 2.*

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This drawing is a reproduction of  
the Original on a reduced scale.

*Fig. 3.*



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